

*On the Development of the Pulmonate Gasteropoda.*

By M. H. FOR.

Although this group of Mollusca has already been the subject of numerous works, the following lines will show how incomplete and erroneous are still the notions that we possess as to their development.

Segmentation takes place in a manner conformable to what is observed in the Heteropoda. In all there is total segmentation, leading to the formation of a blastosphere, the nutritive half of which, consisting of elements of larger size and richer in protoleith, becomes invaginated in the other half. The aperture of invagination is nothing but the primitive mouth, and certainly does not become the anus as Mr. E. Ray Lankester asserts. It occupies at first the nutritive pole—that is to say, the pole opposite to the polar corpuscles (*corpuseules de rebut*); but these two poles soon become displaced, in consequence of the more rapid development of the ventral half of the embryo, in which the foot and the preonchylian invagination originate. The dorsal side of the primitive mouth is surmounted by a projection, which is particularly developed in *Helix*, a projection which enters by degrees into the œsophagus, to form there a winged longitudinal crest which afterwards disappears. This crest, which M. Lhering compares to the velum of other Gasteropoda, has really nothing in common with that organ, and may be related to the analogous projection that I have described in the embryos of the Pteropoda.

The cells of the formative pole secrete between them a liquid which finally detaches all this region of the ectoderm and separates it from the entoderm. The vesicle thus produced occupies, in the aquatic Pulmonata, only the bottom of the dorsal region in the neighbourhood of the shell-depression; in the terrestrial Pulmonata this vesicle occupies the whole of the dorsal region as far as the mouth, and attains considerable dimensions, only diminishing at the moment when the pedal sinuses begin to dilate.

The formation of the digestive tube is the same as in the Heteropoda. The embryonic digestive cavity is filled only with albumen, and not with a compact cellular tissue, as stated by M. Rahl. It never ceases to communicate with the exterior by the ciliated canal of the primitive invagination; only this canal buries itself more deeply at the same time with the neighbouring ectodermic tissues which form the œsophagus and the sac of the radula. The salivary glands are evaginations of the wall of the œsophagus on the sides of the sac of the radula. The deutolecith accumulates in great abundance in a portion of the cells of the embryonic digestive cavity, and forms one nutritive lobe or sac in the terrestrial Pulmonata, two lobes in the aquatic forms. These lobes are directly converted into the liver after the absorption of the deutolecith that they contain; the hepatic cells are the entodermic cells of the nutritive sac, and not mesodermic cells as Mr. Lankester supposes. The intestine and the anus are formed as in the Heteropoda.

The velum occurs in all the aquatic Pulmonata, in which, however, it is but slightly developed, and occurs only in the form of a zone of cilia, interrupted on the back, and extending from the mouth to the dorsal vesicle. In *Helix* the velum affects the same form, and forms two ciliated crescentiform ridges, which extend from the mouth to the neighbourhood of the shell-depression.

The primitive kidney, which had previously been observed only in the terrestrial Pulmonata, occurs also in all the aquatic Pulmonata. In its origin it is a depression of the ectoderm, which is formed immediately below the velar ridge on each side at its posterior third, and becomes elongated forwards. The anterior part is not glandular in the aquatic Pulmonata; it presents the form of a ciliated tube, which opens like a funnel in the interior of the body a little above the mouth. It consequently affects the same form as the segmental organs of certain Vermes. It is this organ that has been taken in *Limnæus*, by M. Rahl, for the œsophageal ganglia. It is undoubtedly also this organ that M. Ganine saw, but describes as a pair of large cells furnished with long efferent ducts.

A little above the vibratile funnels of the primitive kidney, a mass of cells is seen to become detached from the ectoderm. These cells, which Mr. E. Ray Lankester has erroneously taken for the origin of the cerebroid ganglia in *Limnæus*, in reality only give origin to conjunctive tissue. The cerebroid ganglia are subsequently formed, at the moment when the tentacles begin to push forth; they detach themselves from the ectoderm at the base of the anterior side of the tentacles within the zone of the velum; the process by which they are detached is a simple folding in *Ancylus* and *Planorbis*, but a well-marked invagination in the terrestrial Pulmonata. The eyes appear at the upper part of the tentacles, and the otcysts at the sides of the base of the foot, by the same processes of formation as the cerebroid ganglia. The pedal ganglia are always separated from the ectoderm of the sides of the foot by simple folding.

The foot of the aquatic Pulmonata contracts alternately with the neck, thus producing a larval circulation. In the terrestrial Pulmonata the extremity of the foot becomes converted into a great contractile vesicle, which contracts alternately with the dorsal vesicle. This pedal sinus in *Arion* has the form of a very long gut; in *Limax* and *Helix* it is broad and flattened; and in *Helix pomatia* it attains such dimensions that it lines the whole inner surface of the egg-shell. We also find, in *Helix*, on the right side a true larval heart like that of the Prosobranchiata. This larval heart afterwards passes into the pallial cavity, and does not cease beating until long after the definitive heart is formed. The definitive kidney is formed as in the Pteropoda, and communicates with the cavity of the pericardium by a ciliated duct. The heart appears as a simple contractile cavity in the midst of the mesoderm, and afterwards surrounds itself with a pericardium.

Thus the type of development of the Pulmonate Gasteropoda differs but little from that of the freshwater Prosobranchiata, which I have also studied.—*Comptes Rendus*, September 27, 1875, p. 523.